VEROSCAN
NOTHING LEFT BEHIND

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BY ELECTRONIC FILING

Federal Communications Commission
Attention: Julius Knapp
Office of Engineering and Technology
Washington, DC 20554

Re: ET Docket No. 07-257
Veroscan Request for Waiver of Section 15.247(b)

Dear Mr. Knapp:

Veroscan's Request for Waiver is being considered in the above-referenced Docket. Herein we supplement the record with information that has been developed by testing and analysis after the Request was submitted.

We have continued work to improve our approach to the body-scan mode for use in operating rooms, as described in our Request. Our work has been directed particularly to ensuring reliable location of tagged items while operating safely under the Commission's radiofrequency radiation exposure limits.[1]

From experiments that were conducted under our direction, we concluded that using maximum peak power but varying it lower in cycles of five to ten seconds improves the system's ability to accurately locate tagged items, and thereby minimizes exposure to the radiation of the patient and hospital personnel, notwithstanding the higher peaks. Safeguards using timers manage the total average power over time, continuing to keep total exposure well within exposure limits with a margin for error even in the worse case scenarios (maximum time and power).

Designing the equipment to continuously vary the power over time in this manner reduces the total energy transmitted per each measurement. During our measurements we found that in a majority of instances the maximum power is not required for reliable detection, but that it must be available for the unusual case. Therefore we have modified the design of our equipment so that power is reduced through cycling based on the signals being processed. For difficult locations in which maximum power is needed for short duration, the timers designed into all of our equipment will ensure that the total transmit time cannot exceed a maximum of two minutes within any six-minute period based upon the highest possible average power during those two minutes. In most instances the total average power actually will be substantially below the maximum permitted.

For purposes of analyzing and testing our projections, we contracted with a third party. An analysis was performed by Drs. Andrew Blanchard and Cyrus Cantrell of the University of Texas at Dallas. Dr. Blanchard is Senior Associate Dean and Director of School Operations & Financial Affairs, Erik Jonsson School of Engineering & Computer Sciences. Dr. Cantrell is Associate Dean for Academic Affairs, Professor, Director, Photonic Technology and Engineering Center, Department of Electrical Engineering. Their report and numerical results are attached to this letter as Appendices A and B.

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[1] *See* 47 C.F.R. § 1.1310.

Drs. Blanchard and Cantrell used a 7-step approach to their analysis of transmit power, ending with Test Case #7 for three peak power levels: 25 watts, 50 watts, and 75 watts. Test Case #7 is consistent with the proposed method while in the body-scan mode. In this mode, the body scan wand would maintain our prior stated 25 percent duty cycle and maximum 2 minutes of transmission per 6 minutes of use (33% long term duty cycle). Additionally, we determined that a 50 percent antenna coupling factor is a conservative high bound. It will be less, but we are using the 50 percent number to stay on the conservative side.

We also are taking into account that the wand will be scanned over an area at least 6 times that of the antenna face, and once again, being very conservative, we have decreased this to 30 percent (30% illumination coverage) as opposed to a more realistic value of 16 percent. We then added a 50 percent value for the long period amplitude modulation (50% power ramp). The result is a value of MPE (maximum permissible exposure) of 23.9 W/M^2 for a 75 watt peak power case, more than 20 percent below the maximum permissible value of 30.5 W/M^2 at 915 MHz (band center) calculated using the most recent IEEE Standard.[2] It also should be noted that the values themselves used in the IEEE standard include a substantial safety margin.

Finally, in our design the equipment will maintain a running cumulative total of exposure so that the final exposure total can never exceed 25 W/M^2 averaged over any 6 minute period. This is below the Commission's (and IEEE's) exposure limit and provides additional safety.

Consequently, based on the above new design of varying power from high to low, the safeguard designed into our equipment, and the analysis and information contained in the documents attached to this submission, we respectfully ask that our request be amended to provide a maximum peak radiated power of 75 watts. Because the higher power enables more rapid and reliable locating of the tag, the effect is to minimize exposure as compared with our original request. This amendment will not affect complete compliance with the Commission's radiation limits – even in the worse case the maximum exposure will be more than 20 percent less than allowed by both the Commission's Rules and the IEEE Standard.

Thank you for your consideration.

Sincerely,

John Volpi

John Volpi
Chief Technology Officer

Attachments:
- Appendix A – Report on Transmit Power Review
- Appendix B – Power Density Analysis

[2] The Commission's requirements at 915 MHz are identical to those of the most recent IEEE Standard used by Drs. Blanchard and Cantrell, C95.1-2005, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Fields, 3 kHz, to 300 GHz. The value of 30.5 W/M^2 is identical to the value as specified in Table 1A, Page 67, Limits for Maximum Permissible Exposure, FCC OET Bulletin 65, Edition 97-01 of 3.05 mW/cm^2

APPENDIX A

VEROSCAN, Inc
Statement of Work (SOW)

Transmit Power Review

Introduction:

This SOW was performed as a review of the transmit strategy to be employed within the mobile wand of the Veroscan Operating Room Tracking System. The transmit strategy was reviewed in light of the IEEE C95.1.

The work was performed by Drs. Andrew Blanchard and Cyrus Cantrell, collaborating with John Volpi of Veroscan Inc. The intent was to evaluate the total power and energy levels utilized in the Veroscan wand and document the performance to evaluate the radiation environment dictated by the IEEE C95.1 safety standards[1]. The operational specifications were documented in the attached SOW from Veroscan. Additional calculations were performed to allow some evaluation of system conditions and the potential of expanding t he operational envelope of the wand.

Background:

The measurement configuration is complex. The wand operates in the near field of the radiation structure. The target is geometrically complex. As a result, a direct calculation of the spatial distribution[2] is neither reasonable nor relevant in this study. Our analytical approach incorporates a process to evaluate the worst-case conditions with progressive calculations to reflect more realistic operational conditions. This allows a contextual reference of potential operational issues and allows the design team to consider multiple operational configurations.

Seven experimental configurations were evaluated, each at three transmit power levels, 25 watts, 50 watts and 75 watts. Test case number 1 identified the worst-case scenario: Full CW power with no duty-cycle average-power reductions, and all radiated power subtended in the area occupied by a 15 cm diameter circular aperture antenna. This case represents the maximum intercepted power density coupled to the patient. We make the assumption that none of the power radiated is reflected from the patient and all is coupled into the patient cavity. This is an unrealistic assumption given the reflection discontinuity caused by the difference in dielectric constant between the patient and free space (~45 for humans[3] at 900 MHz and 1 for the air gap between the antenna and the human). We also make the assumption that the distribution of the electric field across the aperture is uniform.

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[1] IEEE Standard C95.1-2005, Table 8

[2] Man-Faï Wong and Joe Wiart, "Modelling of electromagnetic wave interactions with the human body", Comptes Rendus Physique **6**, 585–584 (2005)

[3] http://www.fcc.gov/fcc-bin/dielec.sh

Test case 2 and 3 calculate the reduction in power density under the assumption of a 50% and 25% pulse duty cycle, respectively. Test case 4 allows that some of the radiated energy is directed away from the main beam of the antenna into the side lobes. In a conservative assumption, we estimate for this test case that 50% of the radiated power is diverted to the side lobes and does not couple into the patient. Test case 4 places additional realistic constraints by imposing a 50% ramp in the radiated power level. This additional 50% duty cycle further reduces the intercepted power density levels. Test case 6 incorporates the six-minute patient measurement duty cycle. We make the assumption that the scanning procedure will allow power to be radiated for no more than 2 minutes over any six-minute measurement cycle. This corresponds to a 30% temporal duty cycle. Finally, test case 7 incorporates worst-case spatial scanning procedures by allowing any one sector (corresponding to the coupled area of the antenna) to be illuminated for only 30% of the two-minute temporal measurement cycle.

Results:

The results of the test case calculations are summarized in the attached spreadsheet. The relevant standard for MPE at 900 MHz is set forth in IEEE Standard C95.1, Table 8. The operational constraints protect patient MPE to the more stringent controlled exposure MPE requirements of 30 W/m^2. Our calculations, under the previously identified assumptions, indicate that there are test cases in which the minimum MPE for controlled exposure is not exceeded for the three power levels investigated. There are significant safety factors for the 50 and 25 watt radiated power cases. The minimum-level MPE's are met in test cases 6 and 7 for 25 W and test case 7 for 50 W and 75 W. Our calculations also indicate that some level of flexibility in radiated power configuration and duty cycle may be allowed at a total power of 25 W while continuing to meet appropriate MPE levels. Test cases 5 and 6 represent substantially increased duty cycles (temporal and spatial).

Signed:

Andrew Blanchard

A J Blanchard

Cyrus Cantrell

C. D Cantrell

Appendix B

Power Density Analysis

Test Case	Antenna Size (cm)	Transmit Pwr (W)	Range (cm)	Duty Cycle (%)	Antenna Gain	Power mode	Total Incident Pwr (W/sqcm)	Total Incident Pwr (W/sqM)	Allowable Pwr Density (W/sqM)	MPE (W/sqM)	Notes
#1	15	25	3	100%	100	1	0.1415	1415.4	4.5	30	Full power CW
#2	15	25	3	50%	100	1	0.0708	707.7	4.5	30	full power 50% duty cycle
#3	15	25	3	25%	100	1	0.0354	353.9	4.5	30	Full power 25% duty cycle
#4	15	25	3	25%	50	1	0.0177	176.9	4.5	30	Full power 25% duty cycle, 50% antenna coupling
#5	15	25	3	25%	50	0.5	0.0088	88.5	4.5	30	Full power 25% duty cycle, 50% antenna coupling, 50% power ramp
#6	15	25	3	25%	50	0.5	0.0027	26.5	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle
#7	15	25	3	25%	50	0.5	0.0008	8.0	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle, 30% illumination coverage duty cycle

Test Case	Antenna Size (cm)	Transmit Pwr (W)	Range (cm)	Duty Cycle (%)	Antenna Gain	Power mode	Total Incident Pwr (W/sqcm)	Total Incident Pwr (W/sqM)	Allowable Pwr Density (W/sqM)	MPE (W/sqM)	Notes
#1	15	50	3	100%	100	1	0.2831	2830.9	4.5	30	Full power CW
#2	15	50	3	50%	100	1	0.1415	1415.4	4.5	30	full power 50% duty cycle
#3	15	50	3	25%	100	1	0.0708	707.7	4.5	30	Full power 25% duty cycle
#4	15	50	3	25%	50	1	0.0354	353.9	4.5	30	Full power 25% duty cycle, 50% antenna coupling
#5	15	50	3	25%	50	0.5	0.0177	176.9	4.5	30	Full power 25% duty cycle, 50% antenna coupling, 50% power ramp
#6	15	50	3	25%	50	0.5	0.0053	53.1	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle
#7	15	50	3	25%	50	0.5	0.0016	15.9	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle, 30% illumination coverage duty cycle

Test Case	Antenna Size (cm)	Transmit Pwr (W)	Range (cm)	Duty Cycle (%)	Antenna Gain	Power mode	Total Incident Pwr (W/sqcm)	Total Incident Pwr (W/sqM)	Allowable Pwr Density (W/sqM)	MPE (W/sqM)	Notes
#1	15	75	3	100%	100	1	0.4246	4246.3	4.5	30	Full power CW
#2	15	75	3	50%	100	1	0.2123	2123.1	4.5	30	full power 50% duty cycle
#3	15	75	3	25%	100	1	0.1062	1061.6	4.5	30	Full power 25% duty cycle
#4	15	75	3	25%	50	1	0.0531	530.8	4.5	30	Full power 25% duty cycle, 50% antenna coupling
#5	15	75	3	25%	50	0.5	0.0265	265.4	4.5	30	Full power 25% duty cycle, 50% antenna coupling, 50% power ramp
#6	15	75	3	25%	50	0.5	0.0080	79.6	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle
#7	15	75	3	25%	50	0.5	0.0024	23.9	4.5	30	Full power 25% duty cycle 50% antenna coupling, 50% power ramp, 30% long term duty cycle, 30% illumination coverage duty cycle